2. SOIL STRATIGRAPHY STUDIES

PARENT MATERIALS OF YELLOW-BROWN LOAMS IN THE WAIKATO-COROMANDEL DISTRICT

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The yellow-brown loams of the Waikato-Coromandel region are derived from weathered airfall volcanic materials. These materials may be either direct airfall deposits, or erosion products of these deposits, described as reworked ash in some publications. In the erosion products small amounts of other rocks may be included in the parent materials, and these additions may modify to a slight degree the chemical and physical properties of the soil as a yellow-brown loam. In larger amounts these additions result in the formation of intergrades to yellow-brown earths or gley soils.

The volcanic ash materials may be of either andesitic or rhyolitic ash composition; commonly they are of mixed origin due to accumulation at different times from differing sources. These sources extend in a semi-circle of centres from Mt Egmont through the Tongariro National Park volcanoes, Taupo and Rotorua to Mayor Island in the Bay of Plenty. The proportional contributions to the present soils differ with distance from the particular source and with the directional distribution of the materials. For example, the elongated patterns of tephras from historic eruptions of Mts Ngauruhoe and Ruapehu demonstrate the effect of contemporaneous wind currents. Local topographic features and aspect alter thicknesses of the ash deposits.

Early field research separated two major soil-forming materials of yellow-brown loams in the Waikato which were named Mairoa Ash and Tirau Ash (Grange 1931; Grange & Taylor 1932). Whilst the two overlapped, studies indicated that the Tirau Ash was primarily rhyolitic and was the parent material of soils for about 30 km north-west of the boundary of soil-forming thicknesses of Taupo Pumice. Mairoa Ash extended westward from the Tirau Ash boundary to the west coast. These names were used during the General Survey of Soils of North Island, and two more—Waihi Ash and Whangamata Ash—were added to describe soil-forming tephras in the north-eastern part of the Waikato-Coromandel region i.e. beyond the Tirau Ash boundary (Taylor 1953). For purposes of soil description and classification the deposits were named Ash although believed to be composed of materials from several eruptions. Using the plural Ashes may have made this clearer.

The Ashes were commonly recognised and described primarily from their properties and composition as seen in the B and C horizons of the soil profiles (e.g. Ward 1967; Gibbs 1968; N.Z. Soil Bureau 1968; Bruce 1978). Where the deposits were limited to a contribution to the A horizon, the soil-forming materials were usually named as the underlying older tephra e.g. Hamilton Ash, or as non-igneous rocks such as greywacke (N.Z. Soil Bureau 1954). Thus the thin deposits of less than 10 cm of Taupo, Kaharoa, Tarawera and Ngauruhoe Tephras were omitted from the maps and descriptions of the materials forming the soil group. However they were included in interpretations of the chemical and mineral analyses of horizons of soil types.

Recent studies of soil profiles in the Waikato-Coromandel region (Pullar 1967; Pullar & Birrell 1973b; Hodder 1974; Hodder & Wilson 1976; Hogg 1979), stratigraphic classification of ash beds in adjoining districts (Vucetich & Pullar 1969; Neall 1972; Topping 1973; Pullar & Birrell 1973a; Howorth 1975; Lowe 1979) and examination of cores from peat swamps and lake sediments (Tonkin 1967; Davoren 1978; Low *et al.* 1980) have supplied mineralogical, geochemical and age evidence of specific tephra at particular sites. These indicate potential contributions to parent materials of yellow-brown loam soils on adjacent sites, some of which were used in preparing isopach maps of showers (Pullar & Birrell 1973a). However, owing to the likely variations in original deposition over the region, and to the effects of erosion, biological transfers and weathering since deposition, there is no surety of uniform constitution of parent materials for either the group or the type of soil. Moreover, even at studied sites there are deposits of unidentified materials and no certainty that a complete column of tephra has been constructed. In the circumstances, use of Mairoa, Tirau, Waihi and Whangamata Ashes as terms for the composite parent materials of the yellow-brown loams is being continued in soil descriptions. This practice does not restrict the identification of component tephras for stratigraphic purposes. It allows the unnamed tephra deposits to be included in the stratigraphic column once they have been positively identified.

On existing information (e.g. Lowe 1981) the following conclusions may be drawn:

—Mairoa Ash is derived principally from deposits of as yet undifferentiated multiple beds of andesitic

tephra from Egmont and Tongariro centres and of rhyolitic tephras from Taupo, Maroa and Okataina Centres. Thin deposits of Taupo, Rotoma, Opepe?, Waiohau, Rotorua, Rerewhakaaitu, Oruanui, Tahuna? and Rotoehu Tephras are likely to constitute most of the rhyolitic materials and the proportions of the older deposits will tend to increase westward with distance from the source.

—Tirau Ash is derived principally from deposits of rhyolitic tehpra from the Okataina Centre (Rotoma, Waiohau, Rotorua, Rerewhakaaitu, Okareka Tephras) with small additions of andesitic materials (origin uncertain) and of Kaharoa Ash and Taupo Pumice.

—Waihi Ash is derived principally from rhyolitic tephra from the Okataina Centre, but of differing proportions from Tirau Ash (Kaharoa, Mamaku, Rotoma, Rotorua, Waiohau?, Okareka?, Hauparu and Rotoehu Tephras) and small additions of Taupo Pumice and Tuhua Tephra.

—Whangamata Ash was originally applied to the coarse textured material in soil profiles in the eastern side of Coromandel Peninsula. Recent detailed studies by Hogg (1979) have shown that this material is in part composed of a widespread deposit from Mayor Island about 6000 ^{14}C years ago for which the name Tuhua Tephra Formation has been proposed for stratigraphic purposes. This tephra is characterised by a peralkaline assemblage of minerals including aegirine not found in other tephras. The presence of aegirine allows the tephra to be recognised and identified separately in composite deposits, and small quantities have been detected in the Mairoa Ash and in Tirau Ash up to 100 km from Mayor Island. This is a further demonstration of the composite nature of soil-forming deposits of volcanic ash in the North Island and of the value for geographic names for these materials.

No area of soil is known to be formed entirely from Tuhua Tephra, but where it was the major component of the parent material Whangamata Ash has been used (N.Z. Soil Bureau 1954). This usage can continue with the added information that small quantities of Tuhua Tephra may contribute to the parent materials of Waihi, Tirau and Mairoa Ashes.

The yellow-brown loams in terraces and fans are formed chiefly from sandy and gravelly alluvial or colluvial deposits. These deposits are derived from erosion of Pleistocene ashfall and ignimbrite materials mixed with small amounts from older underlying rocks, collectively classified as the Hinuera Formation (Hume *et al.* 1975). The age of the upper surface is estimated as 10 000 years, and thin deposits of more recent eruptions may be included in the soil-forming materials.

In summary, the yellow-brown loams of the Waikato-Coromandel region are formed principally from deposits of tephra from eruptions outside the district, and from different sources at various times. This marginal situation is reflected in the composite nature of the soil-forming materials.